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INSTRUCTION MANUAL

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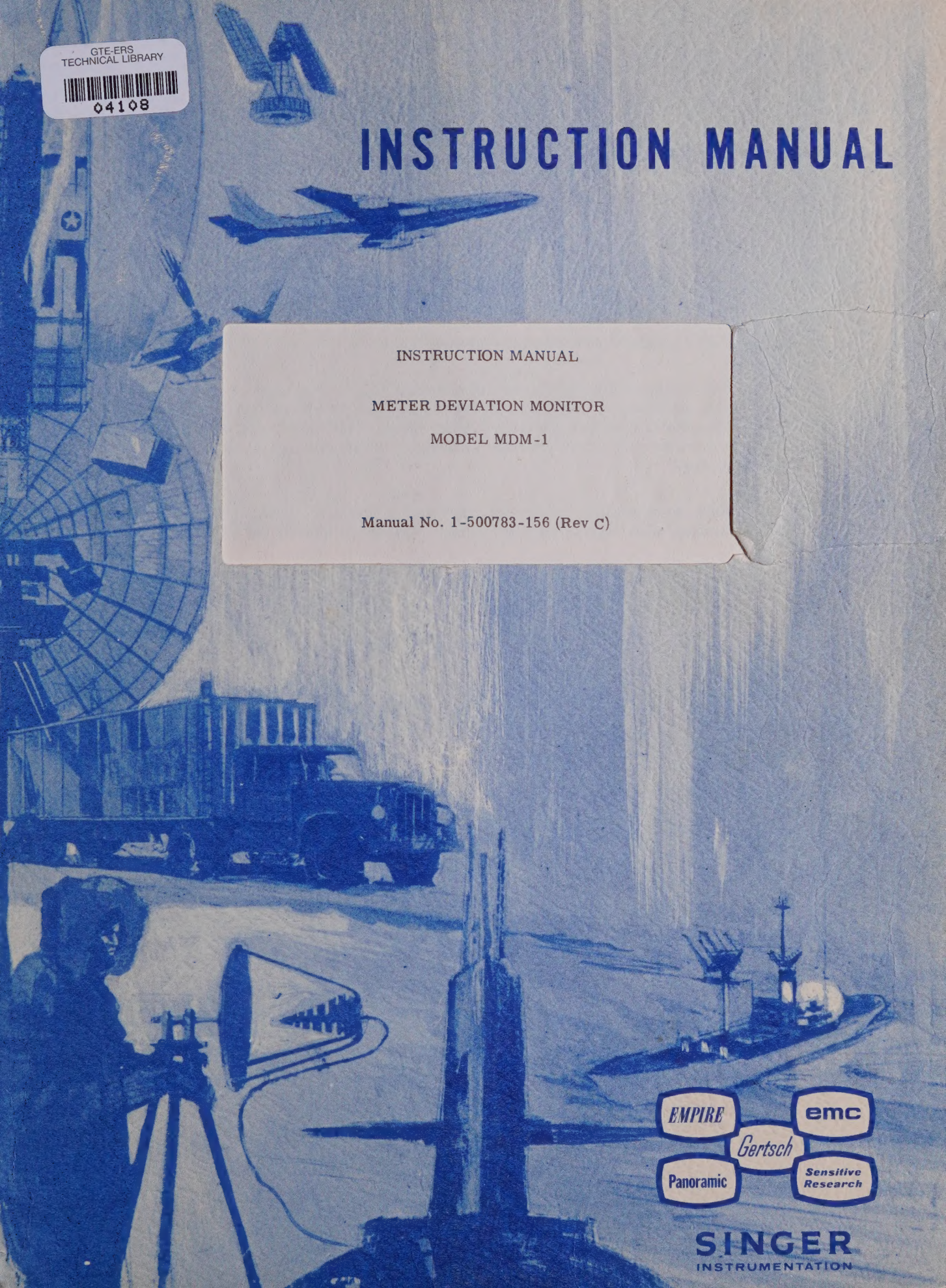
METER DEVIATION MONITOR

MODEL MDM-1

Manual No. 1-500783-156 (Rev C)



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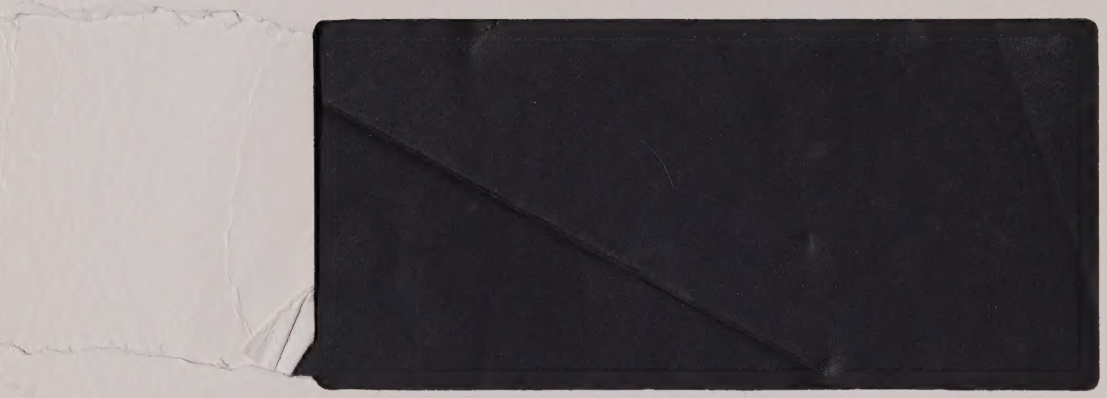

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MODEL MDM-1

Manual No. 1-500783-156 (Rev C)

4/71

The Singer Company, Gertsch Operation
3211 S. La Cienega Boulevard, Los Angeles, California 90016

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1. Model or Type
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5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

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(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

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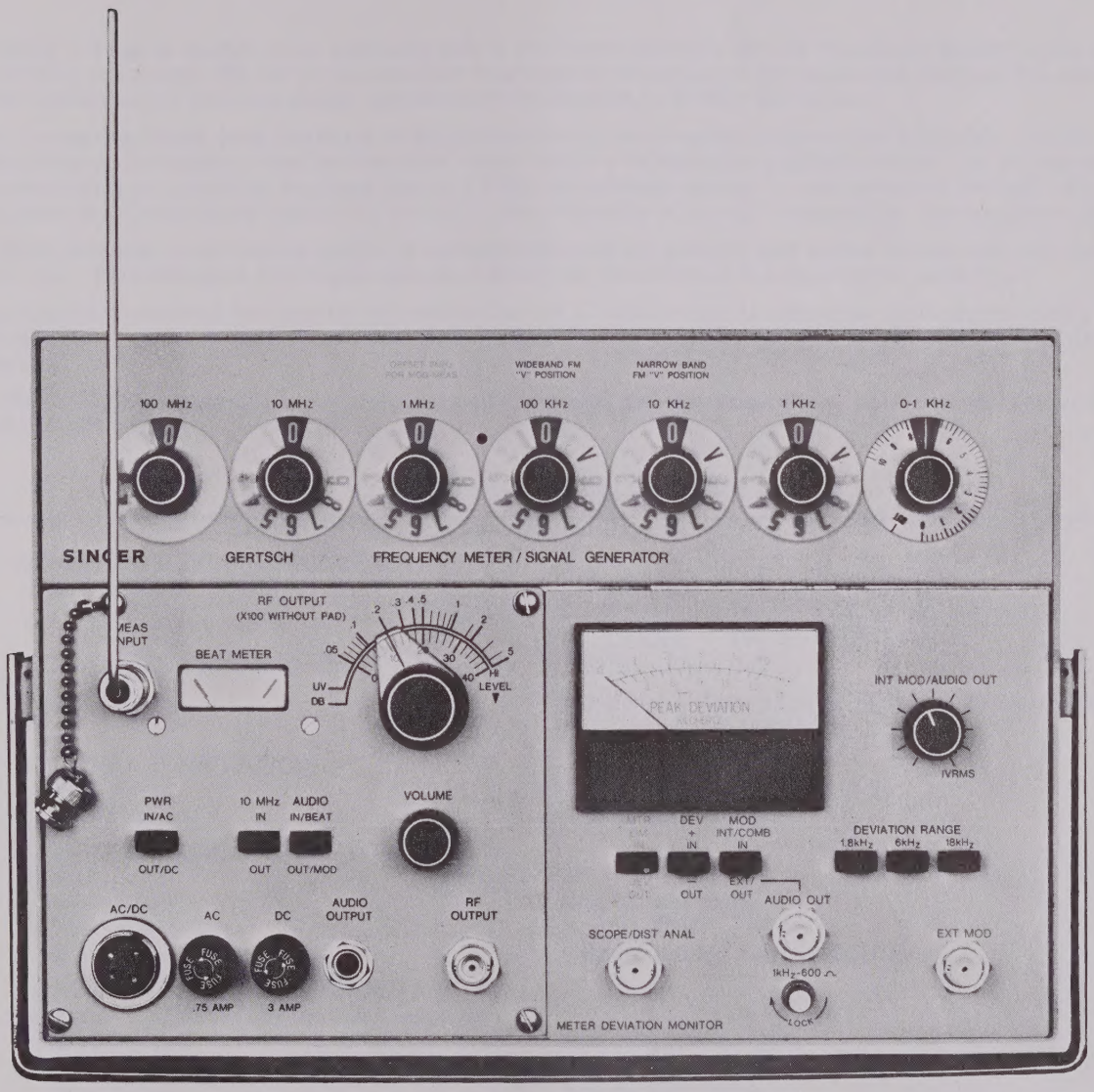


Figure 1-1. Model FM-10 with Meter Deviation Module - Model MDM-1

SECTION I

GENERAL DESCRIPTION

The MDM-1 Plug-in module is an auxiliary unit to the Singer Gertsch FM-10 Frequency Meter/Signal Generator. The MDM-1 equips the FM-10 to generate and measure the deviation of FM modulated signals to a maximum of 18 KHz deviation. It will also supply uncalibrated modulation to 60 KHz deviation.

In the measuring mode, peak deviation is displayed directly on a meter calibrated in Kilohertz. In the FM generating modes, deviation is read on the same meter and is controlled by a potentiometer. An FM signal can be generated using an internally supplied tone of 1 KHz, an external tone or a combination of the two. The 1 KHz modulation tone (controllable from 0-1 vrms) is also available at a front connector for transmitter audio tests.

The peak deviation meter can be quickly switched from reading positive half waves to negative half waves and vice versa. This affords a convenient means of detecting distortion in the transmitter modulator.

Other facilities provided for monitoring modulation are a loudspeaker presentation of the demodulated signal (controllable in volume) and a front panel signal output jack for connection to an oscilloscope or distortion analyzer.

The FM-10/MDM-1 provides a complete and self-contained FM communications field test package in the range 50 KHz to 500 MHz.

TABLE 1-1. SPECIFICATIONS

DEVIATION RANGES & ACCURACY:	
At 1 KHz Mod. Freq.	0 - 1.8 KHz: 180 Hz ± 5% of F.S. 0 - 6 KHz: 180 Hz ± 5% of F.S. 0 - 18 KHz: 180 Hz ± 5% of F.S.
At 50 Hz & 3 KHz Mod. Freq.	180 Hz ± 7% of F.S.
SENSITIVITY:	6 Mv rms ± 3 db (10 MHz to 500 MHz) for red line limiter current indication
INTERNAL MODULATION:	
Mod. Freq.	1 KHz ± 5%
Dev. Range	0 to 60 KHz (min)
EXTERNAL MODULATION:	
Mod. Freq.	50 Hz to 3 KHz
Dev. Range	0 to 60 KHz (min)
Input Impedance	Approx 600 Ω
Input Level	Approx 400 Mv rms for 5 KHz dev.
COMBINED MODULATION MODE: (Internal & External Modulation Combined)	
Mod. Freq.	Ext: 50 Hz to 3 KHz Int: 1 KHz ± 5%
Dev. Range	0 to 60 KHz (min)
SCOPE/DIST. ANAL. OUTPUT:	
Mod. Freq.	50 Hz to 3 KHz (3 db)
Output Level	Approx 280 Mv p-p into 1K load at 5 KHz dev.
AUDIO OUTPUT:	
Freq.	1 KHz ± 5%
Voltage	1 V rms ± 3 db into 600Ω load. Continuously variable 0 - 1 V
Source Impedance	600Ω
Distortion	1% (max)
OPERATING TEMPERATURE RANGE:	-5°C to +50°C
WEIGHT:	2 lbs
POWER:	Supplied by FM-10 9 volts D.C. at 100 ma max.

SECTION II
INSTALLATION

2-1. To install the MDM-1 in the FM-10 mainframe, remove the blank plate covering the plug-in aperture by turning the two screws one quarter turn CCW.

2-2. Remove the protective cover on the connector at the rear of the aperture.

2-3. Insert MDM-1 until flush with front panel.

2-4. Turn the locking pawl clockwise until the plug-in is firmly locked.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-1-1. This section contains instructions only for operating the MDM-1 plug-in module in conjunction with the FM-10 mainframe. Refer to the operating manual for the mainframe (manual number 1-500783-155) for mainframe functions such as power supply connections, rf output control, rf signal input set-ups and beat note zeroing procedure.

3-2. OPERATING CONTROLS, INDICATORS AND CONNECTORS.

3-2-1. The functions of all operating controls, indicators and connectors on the MDM-1 module are described in Table 3-1.

TABLE 3-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS
(Keyed to Figure 3-1)

REF DES	PANEL MARKING	TYPE	FUNCTIONS
1	PEAK DEVIATION	Meter	Has two functions controlled by meter switch (MTR): 1. Indicates limiter current 2. Indicates frequency deviation in KHz The limiter current mode indicates whether sufficient IF signal is present to make a deviation measurement. A red line on the scale labelled "LIM CUR" indicates minimum limiter current necessary to make a deviation reading. The scale markings are in KHz.
2	INT MOD/AUDIO OUT	Variable resistor control	Has two functions controlled by modulation switch (MOD): 1. Varies frequency deviation from zero to 60 KHz maximum when modulation switch is in IN (INT/COMB) position. 2. Varies voltage of 1 KHz tone output from 0 to 1 vrms. When modulation switch is in OUT (EXT) position.
3	MTR LIM/IN DEV/OUT	Switch, in/out position pushbutton	Controls function of PEAK DEVIATION meter. IN position: Meter reads limiter current OUT position: Meter reads peak deviation in KHz
4	DEV IN + OUT -	Switch, in/out position pushbutton	Selects positive or negative half waves of recovered modulation. Provides a means of checking distortion of an FM input signal. A difference of peak deviation meter readings in the in and out positions indicates presence of distortion.

FIGURE 3-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (CONT)
(Keyed to Figure 3-1)

REF DES	PANEL MARKING	TYPE	FUNCTIONS
5	MOD INT/COMB IN EXT/ OUT	Switch, in/out position	1. In the IN position, the internal 1 KHz modulation tone and any external tone connected to the external modulation (EXT MOD) connector frequency modulate the RF output. The level of the internal tone is controlled by the INT MOD/AUDIO OUT variable control. 2. In the OUT position, the internal 1 KHz tone is eliminated from the modulation circuit and only the external tone modulates the RF output. In the OUT position, the 1 KHz internally generated tone is available at the AUDIO OUT (1 KHz, 600 ohms) CONNECTOR.
6	DEV, RANGE, 1.8 KHz, 6 KHz, 18 KHz	Switches, in/out position	Switches set frequency range of meter in the deviation mode.
7	AUDIO OUT	Connector, BNC female	Provides 1 KHz output when modulation switch (MOD) is in the OUT (EXT) position. Output level is 0-1 vrms into 600 ohms controlled by INT MOD/AUDIO OUT variable control.
8	SCOPE/DIST ANAL	Connector, BNC female	Provides demodulated signal output for oscilloscope display or analysis by a distortion analyzer.
9	EXT MOD	Connector, BNC female	An external modulation tone may be applied to this connector. A modulation signal applied to this connector will modulate the FM-10 when the modulation switch (MOD) is in both the IN (INT MOD/COMB) position and the OUT (EXT) position.
10	NARROW BAND FM "V" POSITION 10 KHz Dial marking 0-1-2-3-4-5-6-7-8-9-V	Rotary switch, 11 positions	Controls frequency in ten steps of 10 KHz. "V" position switches the 0-1 KHz variable control into circuit with continuous control over range of 100 KHz.
11	WIDEBAND FM "V" POSITION 100 KHz Dial marking 0-1-2-3-4-5-6-7-8-9-V	Rotary switch, 11 positions	Controls frequency in 10 steps of 100 KHz. "V" position switches 0-1 KHz variable control into circuit with continuous control over range of 1 MHz.
12	10 MHz IN OUT	Switch pushbutton	Applies 10 MHz signal direct from TCXO crystal to detector. Produces audio frequency at phone jack with same accuracy as TCXO.
13	AUDIO IN/BEAT OUT/MOD	Switch, pushbutton	IN position In this position, the beat detector circuit is connected to the loudspeaker OUT position In this position, the demodulated audio from the MDM-1 plug-in is supplied to the loudspeaker.

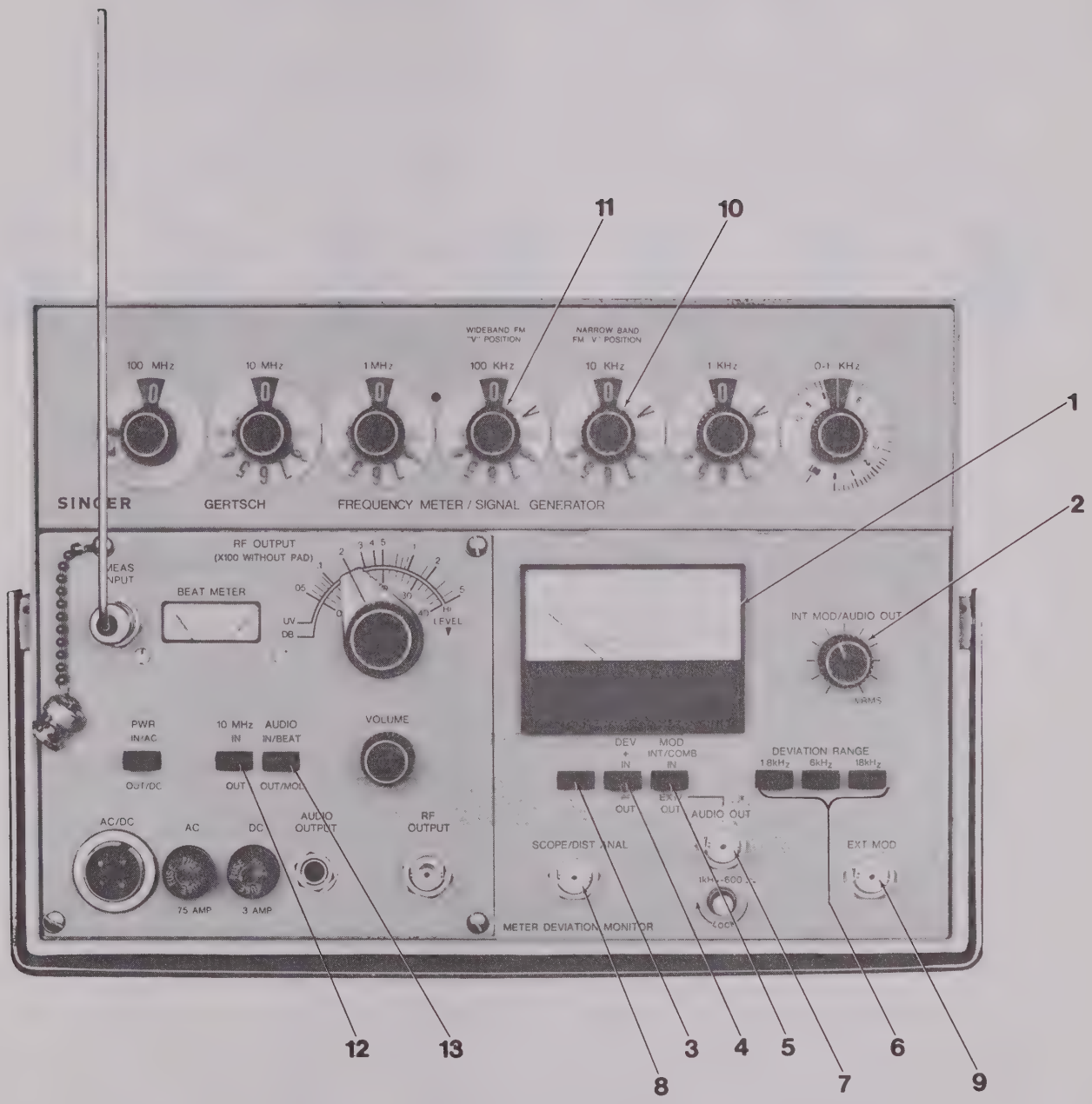


FIGURE 3-1: OPERATING CONTROLS, INDICATORS AND CONNECTORS

3-3. FM DEVIATION MEASUREMENT.

3-3-1. Set frequency decade controls to frequency of test transmitter.

3-3-2. Offset FM-10 frequency by ± 2 MHz.

Example: Transmitter frequency — 276.0359 MHz (see figure 3-2)

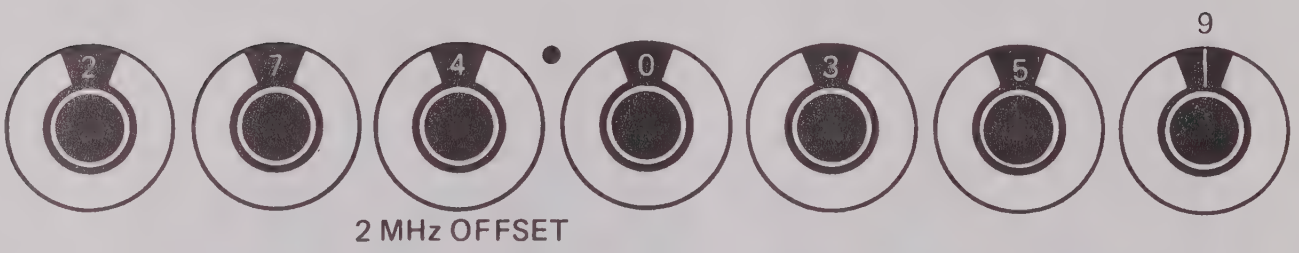


Figure 3-2. Frequency Controls Set-up

3-3-3. Couple transmitter RF output to FM-10 MEAS INPUT jack via antenna provided OR use cable input with an RFA-60 attenuator in the line.

3-3-4. Position other controls as follows:

MTR	IN
AUDIO	OUT
10 MHz switch	OUT
DEV	OUT

3-3-5. Key transmitter (do not modulate).

3-3-6. Increase coupling between transmitter and FM-10 until the limiter current reading on the MDM-1 meter is in acceptable range (see figure 3-3).

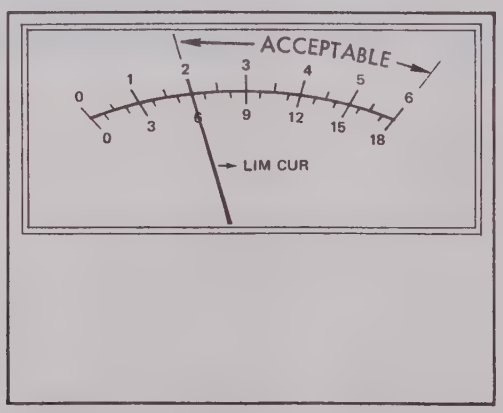


Figure 3-3. Acceptable Limiter Current Range

3-3-7. Push MTR to OUT.

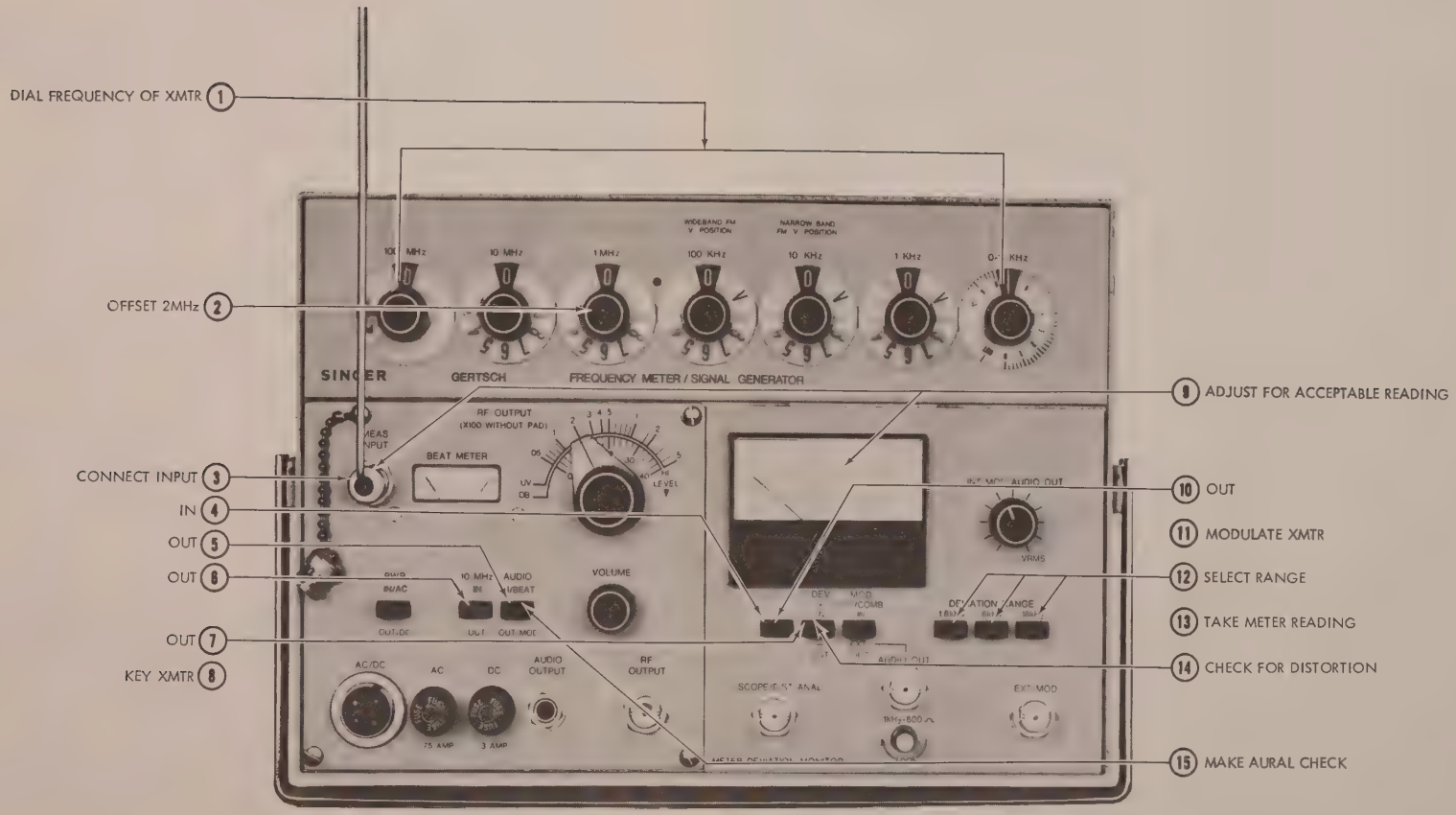
3-3-8. Modulate transmitter by voice or tone.
(Note: 1 KHz tone variable from 0-1 vrms is available at AUDIO OUT. Refer to Section 3-9 for set up.)

3-3-9. Select appropriate DEVIATION RANGE switch for on-scale reading on MDM-1 meter.

3-3-10. Take deviation reading.

3-3-11. Push DEV to IN (+) and OUT (-). If there is noticeable difference in the meter readings in the IN and OUT positions, there is a possibility of distortion in the transmitter modulator.

3-3-12. Monitor the modulation aurally by adjusting VOLUME control to desired listening level.
(Note: To investigate audio distortion further, connect an oscilloscope or distortion analyzer to SCOPE/DIST ANAL output.)



FOLLOW STEPS IN SEQUENCE SHOWN

Figure 3-4. Deviation Measurement – Quick Set-up

3-4. INTERNAL FM MODULATION - PREFERRED METHOD.

Note: An IF. signal of 2 MHz is necessary to generate FM modulation. To produce this 2 MHz signal, the preferred method is to set the FM-10 to the transmitter frequency and offset by ± 2 MHz. When the transmitter output signal is connected into the FM-10, an IF. of 2 MHz is produced. However, the FM-10 can produce the 2 MHz internally and this method is presented as an alternative in paragraph 3-5.

3-4-1. NARROW BAND < 6 KHz

3-4-2. Couple transmitter RF output to FM-10 MEAS INPUT connector via antenna provided OR use cable input with an RFA-60 attenuator in the line.

3-4-3. Position other controls as follows:

10 MHz	OUT
AUDIO	IN
MTR	IN
MOD	IN
DEVIATION RANGE	1.8 KHz or 6 KHz
INT MOD/AUDIO OUT	CCW

3-4-4. Set FM-10 frequency controls to desired carrier frequency.

3-4-5. Adjust frequency of RF generator (if used) until beat note is heard. If using transmitter, key and observe beat note.

3-4-6. Turn 10 KHz control to V position. The functions of the 10 and 1 KHz controls are now taken over by the 0-1 KHz control.

3-4-7. Turn 0-1 KHz control until zero beat note condition is obtained.

Example: For a carrier of 97.352 MHz, the setting will be 5.27 (see figure 3-5).

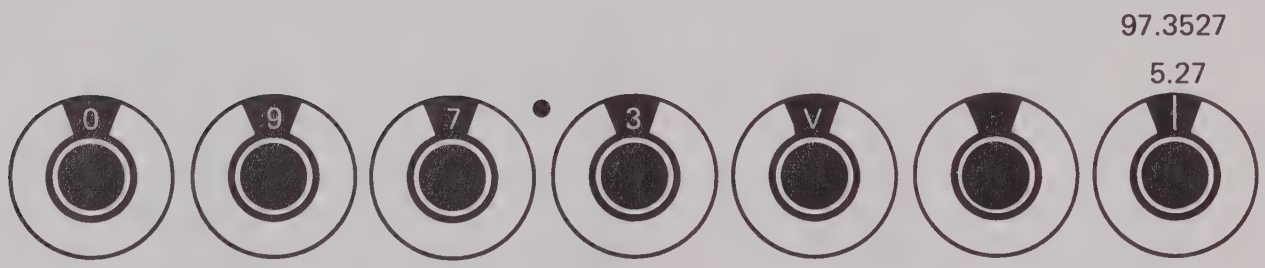


Figure 3-5. Frequency Controls Set-up

3-4-8. Offset FM-10 by ± 2 MHz.

3-4-9. Key transmitter (do not modulate) and increase RF input for limiter current reading in acceptable range.

3-4-10. Push MTR switch to OUT.

3-4-11. Turn INT MOD/AUDIO OUT control to CW until meter indicates desired deviation.

3-4-12. Disconnect signal source from MEAS INPUT.

3-4-13. Turn FM-10 to carrier frequency by removing ± 2 MHz offset.

3-4-14. The FM-10/MDM-1 is now generating an FM output of the desired deviation at 97.3527 MHz.

3-4-15. WIDEBAND > 6 KHz.

3-4-16. The procedure for wideband deviation is the same as for narrowband except set 100 KHz control to V at paragraph 3-4-6 instead of 10 KHz control.

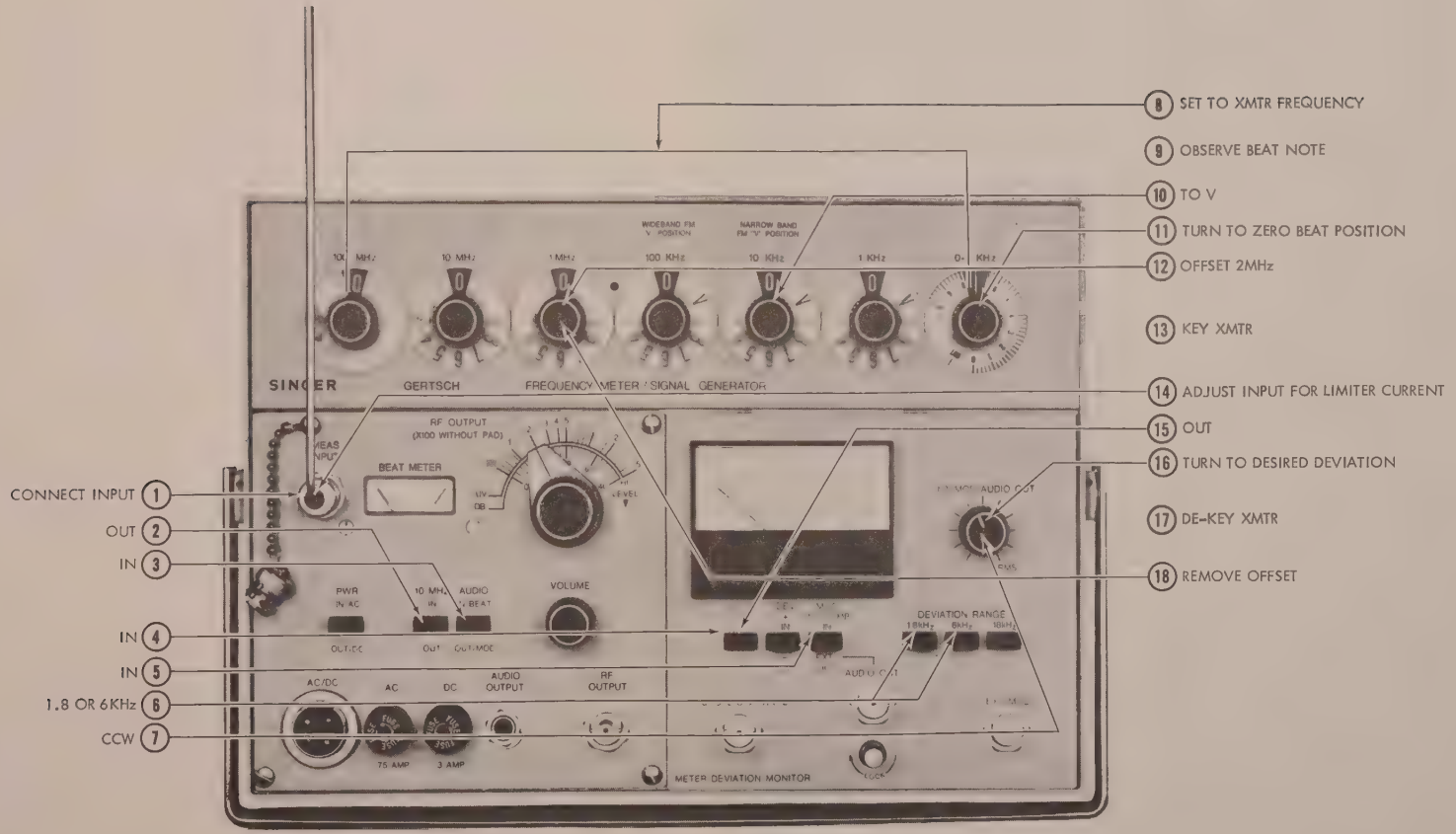


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Figure 3-6. Narrowband Internal Modulation WITH External RF Source – Quick Set-up

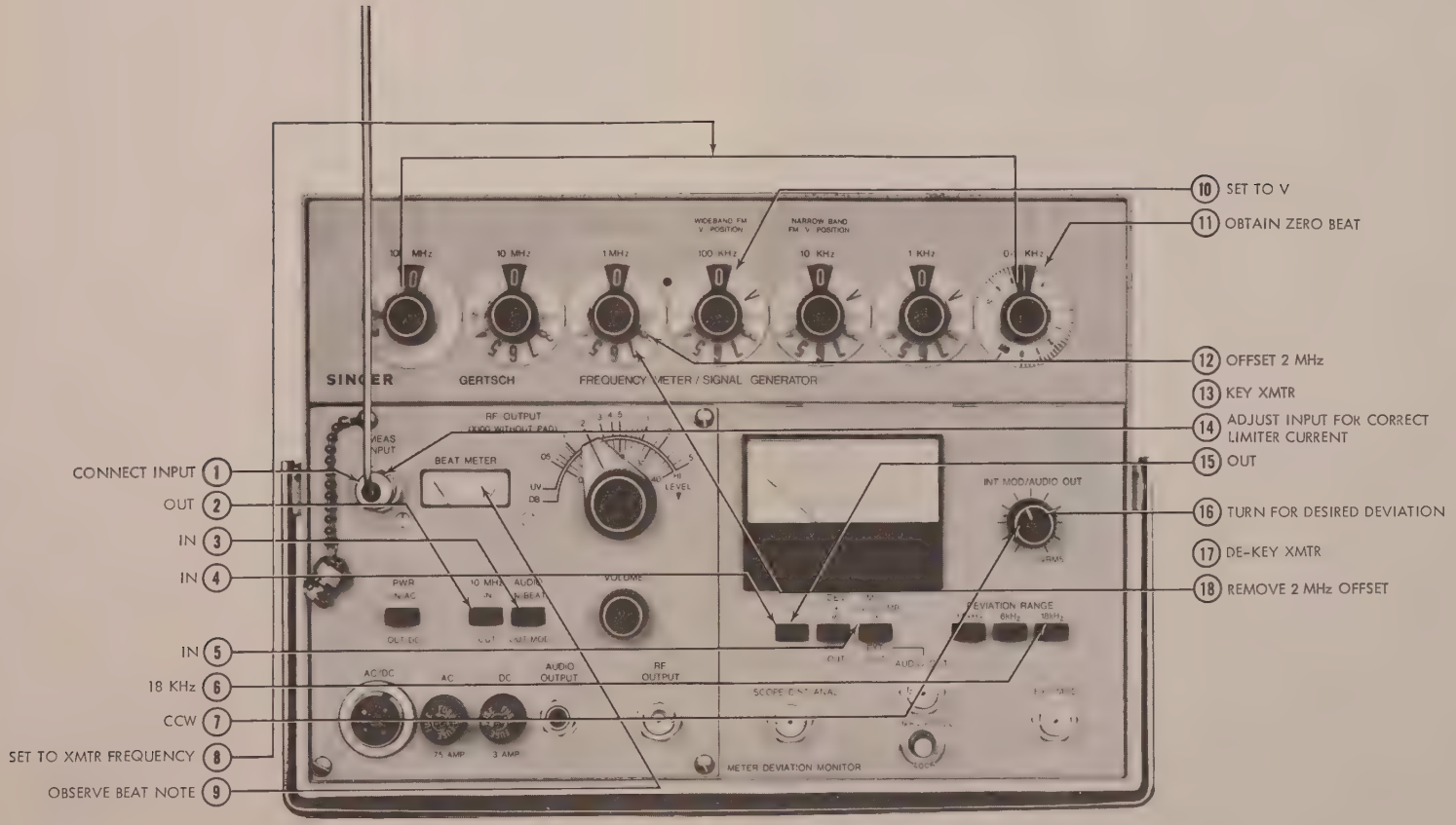

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Figure 3-7. Wideband Internal Modulation WITH External RF Source – Quick Set-up

3-5. INTERNAL FM MODULATION - ALTERNATE METHOD. Without external transmitter or RF generator.

3-5-1. NARROWBAND (0-6 KHz)

Example: Modulate 273.9398 MHz to 5 KHz deviation.

3-5-2. Position controls as follows:

Frequency Controls	0.12.0V00
10 MHz	IN
DEVIATION RANGE	1.8 or 6 KHz
MTR	OUT
MOD	IN
INT MOD/AUDIO OUT	Fully CCW

3-5-3. Turn INT MOD/AUDIO OUT control until meter indicates 5 ~~MHz~~ KHz.

3-5-4. Push 10 MHz switch to OUT.

3-5-5. Set FM-10 frequency controls to desired frequency.

3-5-6. Turn 0-1 KHz control to same value as the 10 KHz and 1 KHz controls.

3-5-7. Turn 10 KHz control to V.

3-5-8. The FM-10/MDM-1 is now generating 5 KHz deviation at 273.939 MHz.

3-5-9. WIDEBAND > 6 KHz

Example: Modulate 273.939 MHz to 15 KHz.

3-5-10. Position controls as follows:

Frequency Controls	012.V000
10 MHz (in-out switch)	IN
DEVIATION RANGE	18 KHz
MTR	OUT
MOD	IN
INT MOD/AUDIO OUT	Fully CCW

3-5-11. Turn INT MOD/AUDIO OUT control until meter indicates 15 KHz.

3-5-12. Push 10 MHz switch to OUT.

3-5-13. Set FM-10 controls to desired carrier frequency.

3-5-14. Turn 0-1 KHz control to value of 100 KHz and 10 KHz controls.

3-5-15. Turn 100 KHz control to V.

3-5-16. The FM-10/MDM-1 is now generating 15 KHz deviation at 273.939 MHz.

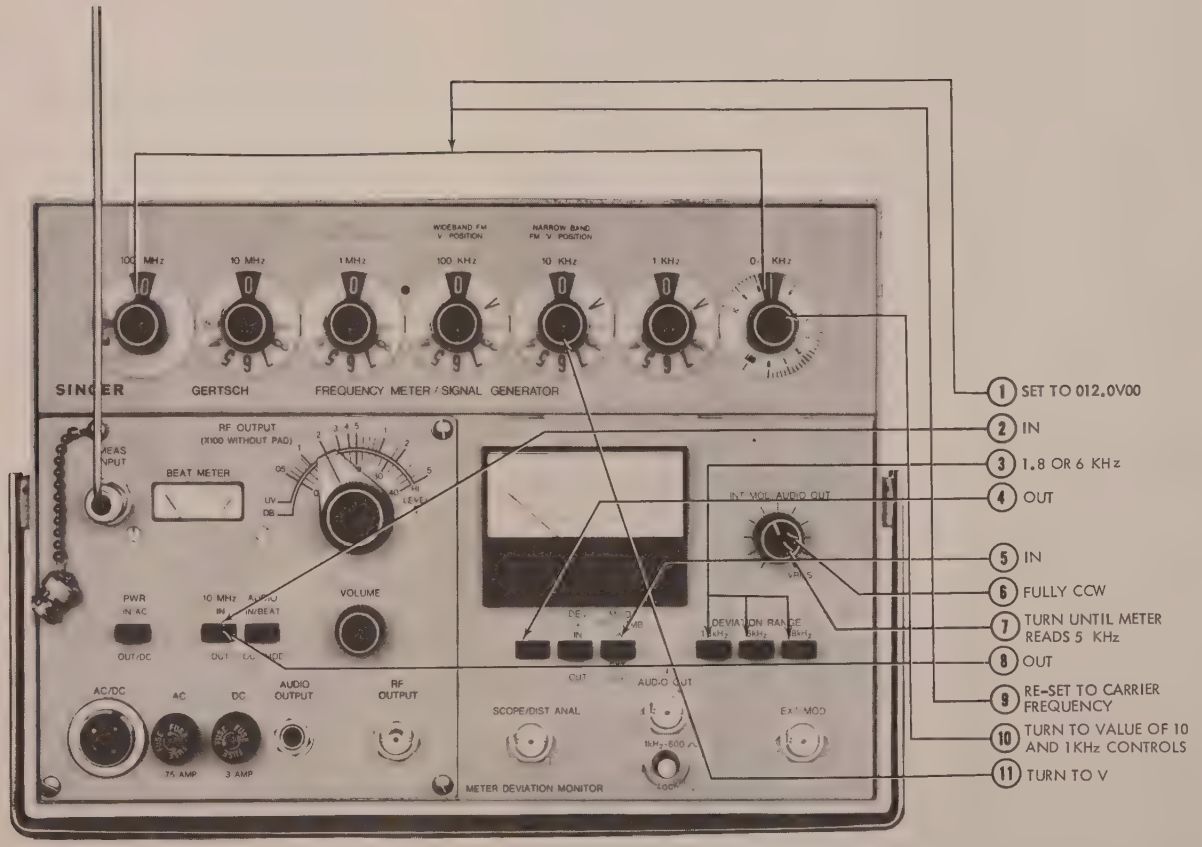

Figure 3-8. Narrowband Internal Modulation WITHOUT External RF Source – Quick Set-up

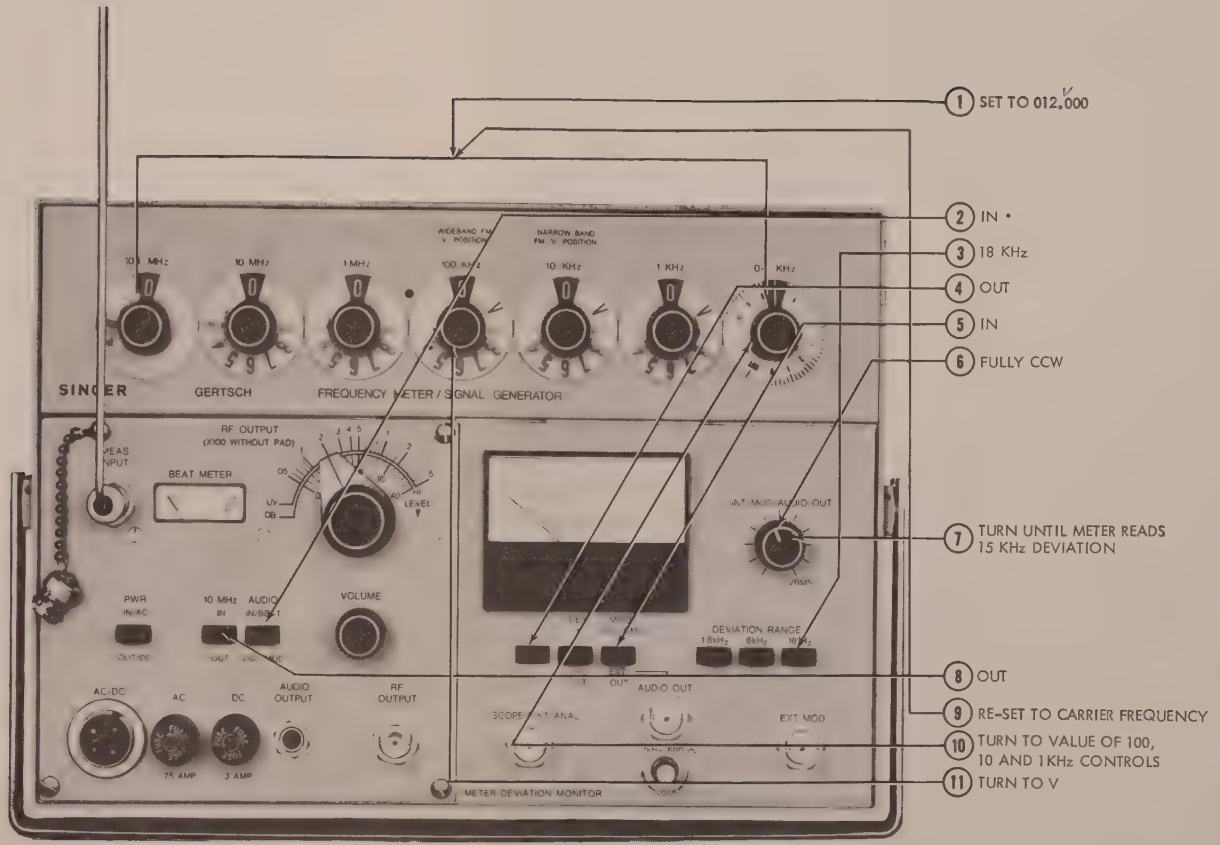

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Figure 3-9. Wideband Internal Modulation WITHOUT External RF Source – Quick Set-up

3-6. FM MODULATION TO 60 KHZ DEVIATION. The FM-10/MDM-1 provides metered deviation to 18 KHz. However, unmetered deviation as high as 60 KHz can be obtained by the following procedure.

Example: Modulate 36.247 MHz to 50 KHz deviation.

3-6-1. Position controls:

Frequency Controls	012.0V00
10 MHz	IN
AUDIO	OUT
INT MOD/AUDIO OUT	Fully CCW
MOD	IN
MTR	OUT

3-6-2. Turn INT MOD/AUDIO OUT control until meter indicates one tenth the desired deviation (5 KHz).

3-6-3. Position other controls:

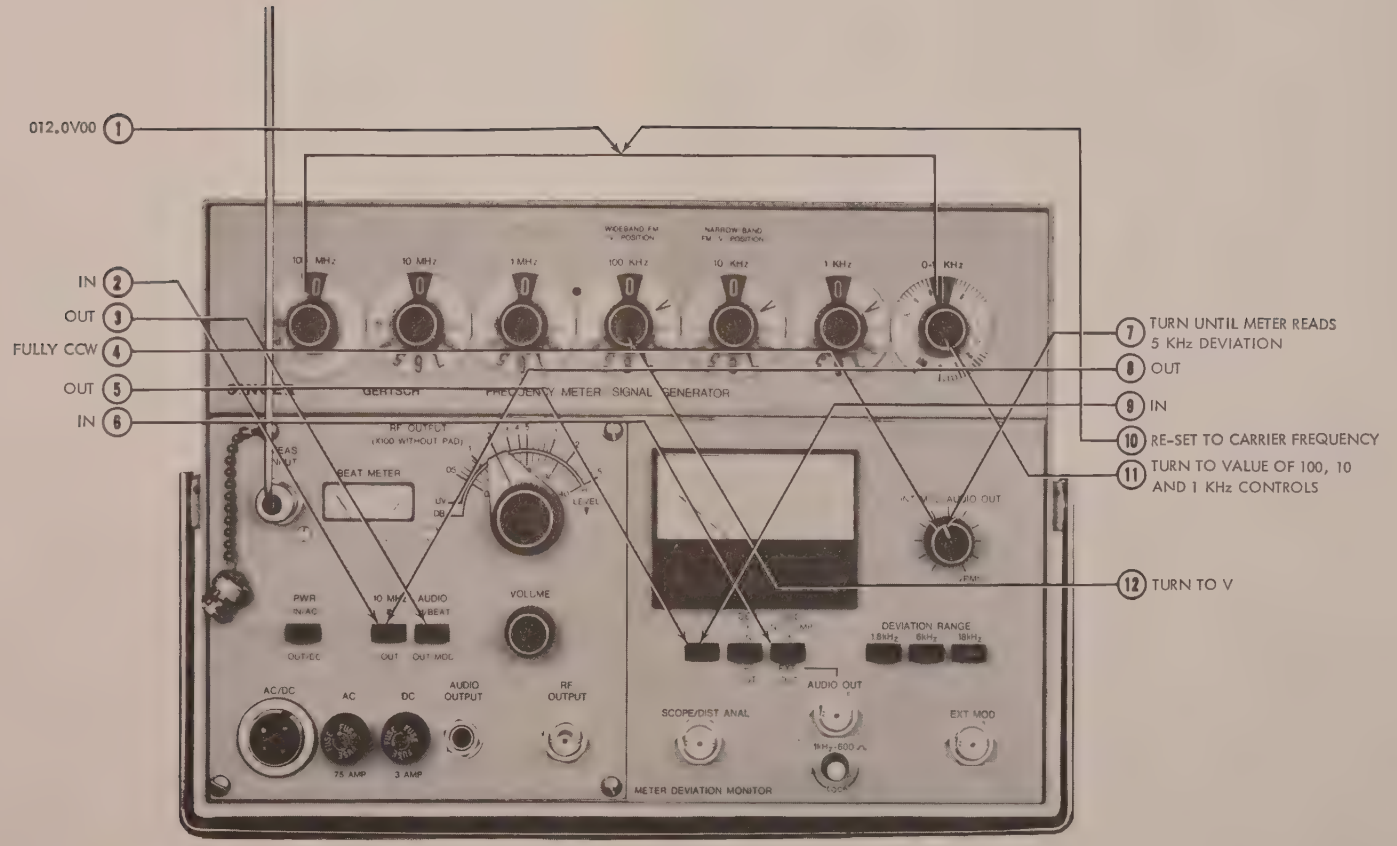
MTR	IN
10 MHz	OUT

3-6-4. Re-set frequency controls to carrier frequency.

3-6-5. Turn 0-1 KHz control to same value as the 100 and 10 KHz controls.

3-6-6. Turn 100 KHz control to V.

3-6-7. The FM-10/MDM-1 is now generating 50 KHz deviation at 36.247 MHz.
Note: The deviation of 5 KHz is initially set up with the 10 KHz control in the V position. This deviation is multiplied x 10 when the 100 KHz control is switched to the V position at step 3-6-6.



FOLLOW STEPS IN SEQUENCE SHOWN

Figure 3-10. 60 KHz Deviation (Unmetered) — Quick Set-up

3-7. COMBINED INTERNAL/EXTERNAL (TWO-TONE) MODULATION.
(Note: An external RF generator or transmitter must be used.)

3-7-1. Set external audio oscillator to desired frequency and set to zero output.

3-7-2. Connect oscillator to EXT MOD.

3-7-3. Couple transmitter RF output to FM-10 MEAS INPUT jack via antenna provided or use cable input with RFA-60 attenuator in the line.

3-7-4. Position other controls as follows:

10 MHz	OUT
AUDIO	IN
MTR	IN
MOD	IN
DEVIATION RANGE	1.8 or 6 KHz
INT MOD/AUDIO OUT	CCW

3-7-5. Set FM-10 to desired carrier frequency.

3-7-6. Adjust frequency of generator (if used) until beat note is heard. If using transmitter, key and observe beat note.

3-7-7. Turn 10 KHz or 100 KHz control to V according to whether narrowband or wideband deviation is required.

3-7-8. Turn 0-1 KHz control until zero beat condition is obtained.

3-7-9. Offset FM-10 by ± 2 MHz.

3-7-10. Key transmitter (do not modulate) and increase RF input to FM-10 until limiter current is in acceptable range (above red line).

3-7-11. Push MTR switch to OUT.

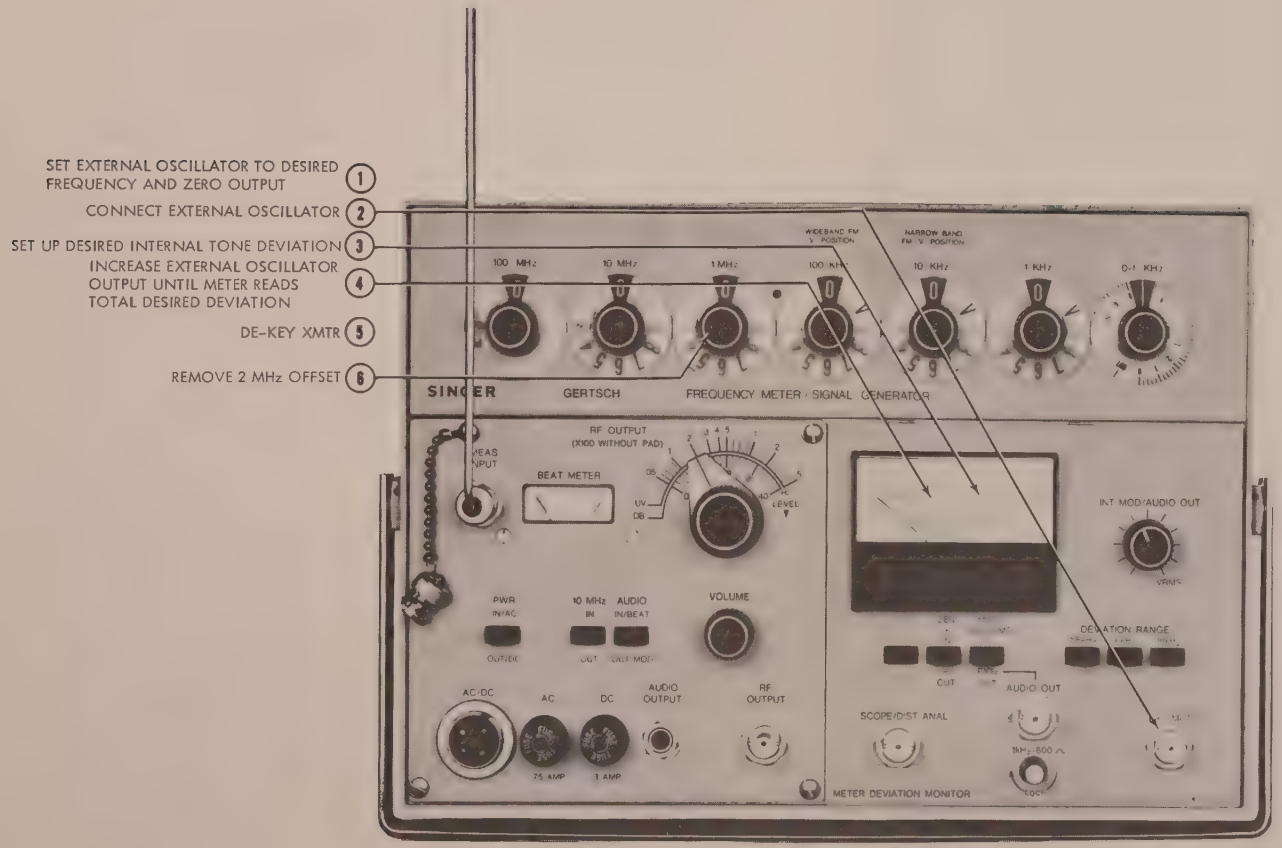
3-7-12. Turn INT MOD/AUDIO OUT control CW until meter indicates desired internal deviation.

3-7-13. Increase output of external oscillator until MDM-1 meter indicates total deviation required.

3-7-14. Disconnect RF input signal source from MEAS INPUT.

3-7-15. Re-set FM-10 to transmitter frequency by removing ± 2 MHz offset.

3-7-16. The FM-10/MDM-1 is now supplying two-tone FM modulation at the desired carrier frequency.

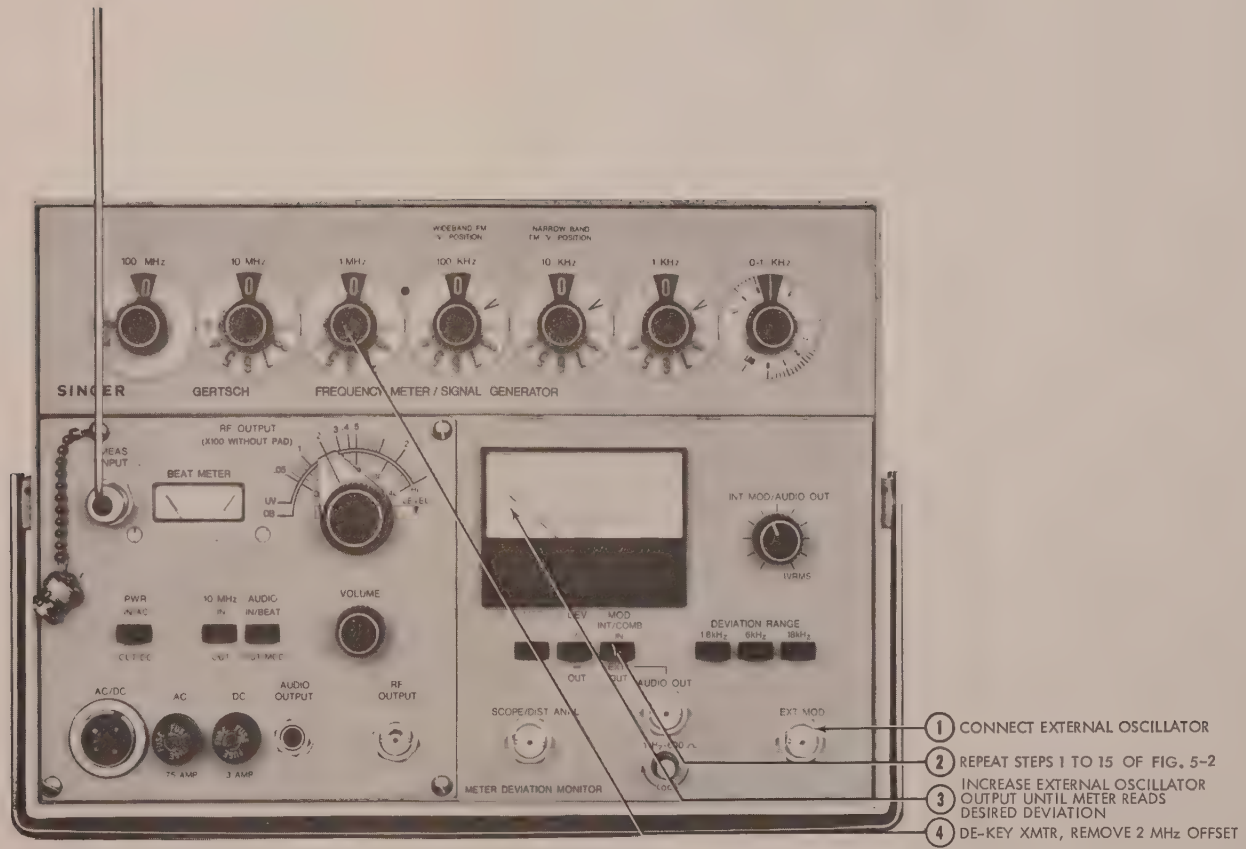


FOLLOW STEPS IN SEQUENCE SHOWN

Figure 3-11. Two-Tone Modulation — Quick Set-up

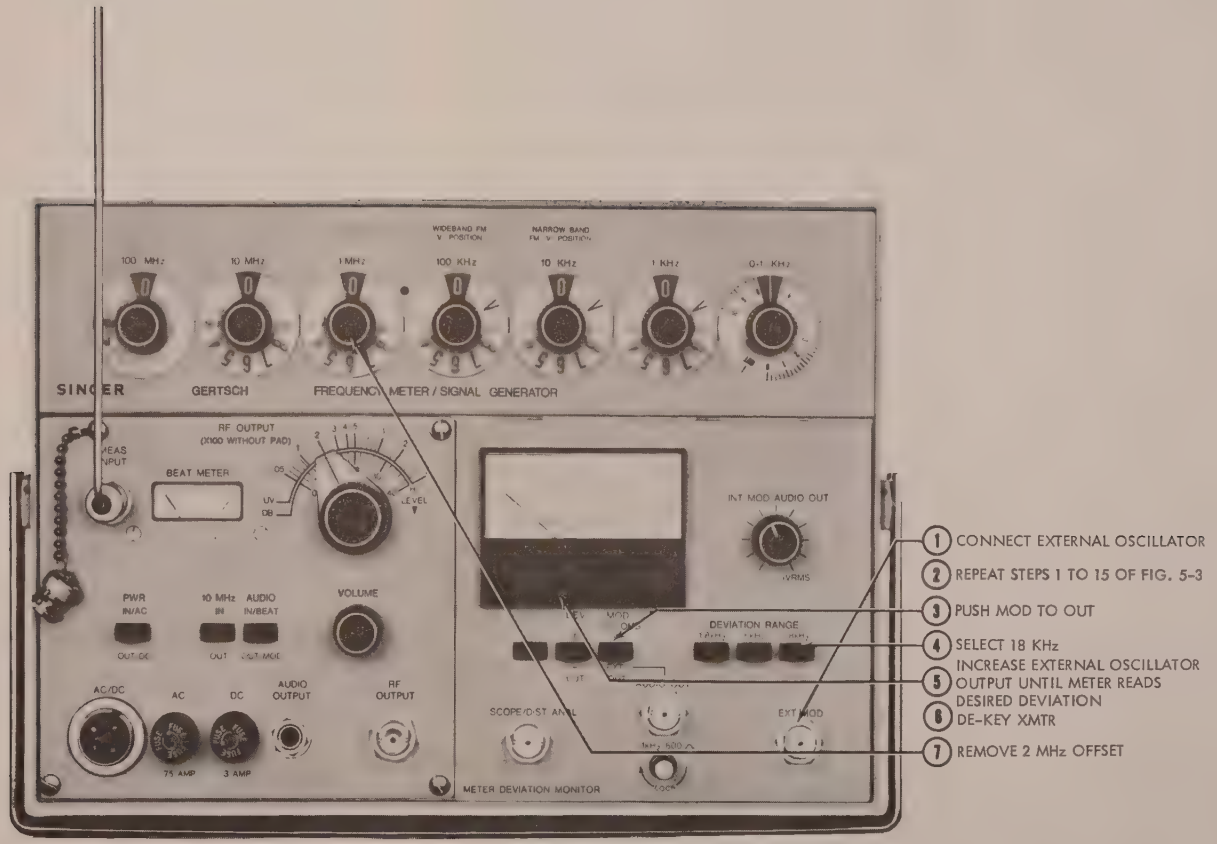
3-8. EXTERNAL MODULATION ONLY.

3-8-1. Repeat 3-7 with MOD switch at EXT/OUT at 3-7-4 and omit internal deviation at 3-7-12.
Note: The internal 1 KHz modulation tone is out of circuit when the MOD switch is at OUT. The INT MOD/AUDIO OUT control therefore need not be set to zero.



FOLLOW STEPS IN SEQUENCE SHOWN

Figure 3-12. External Modulation Only — Narrowband Using External RF Source — Quick Set-up



FOLLOW STEPS IN SEQUENCE SHOWN

Figure 3-13. External Modulation Only — Wideband External RF Source — Quick Set-up

3-9. AUDIO TEST TONE GENERATION.

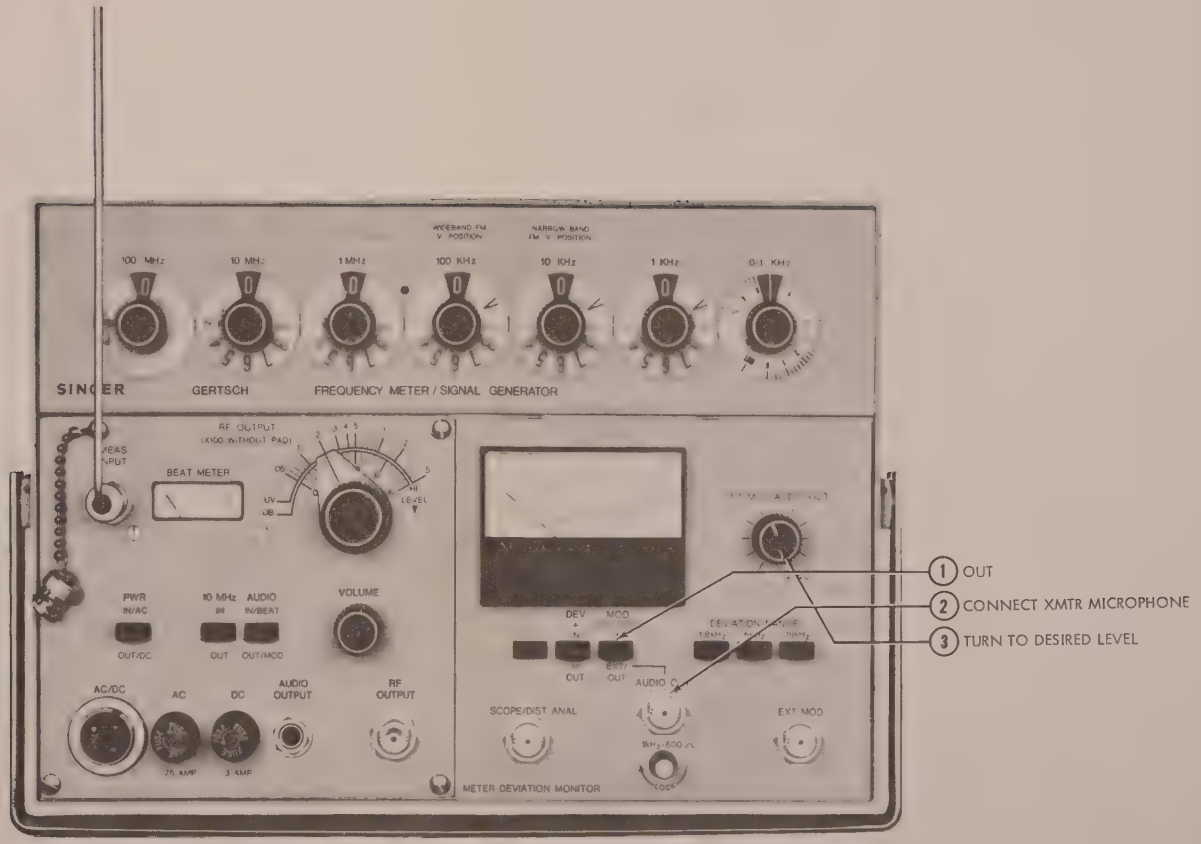
Note: The 1 KHz modulation tone developed by the FM-10/MDM-1 is available at the AUDIO OUT connector for testing of transmitters and repeaters.

3-9-1. Push MOD to OUT.

3-9-2. Connect transmitter microphone input to AUDIO OUT.

3-9-3. Turn INT MOD/AUDIO OUT control to level desired (a maximum of 1 v rms into 600 ohms is available).

3-9-4. The FM-10/MDM-1 is now supplying a 1 KHz tone with 600 ohms output impedance.



FOLLOW STEPS IN SEQUENCE SHOWN

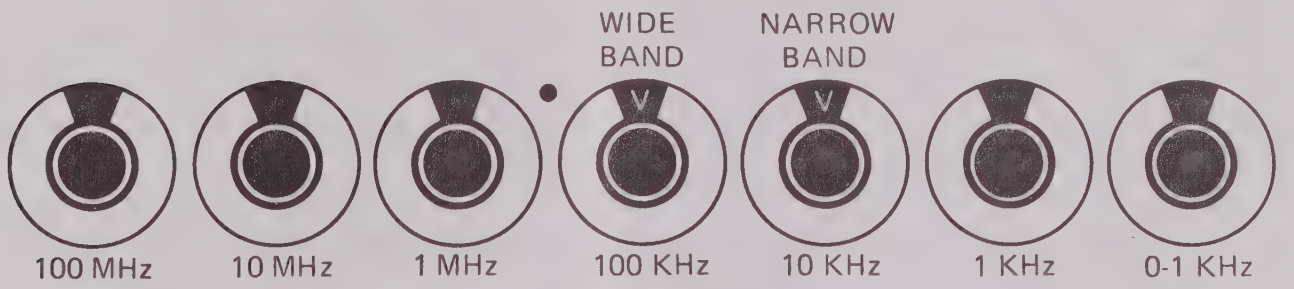
Figure 3-14. Audio Test Tone — Quick Set-up

SECTION IV

THEORY OF OPERATION

4-0. MODULATION

4-1. For modulation to occur, either the 100 KHz or the 10 KHz decade switches (on the FM-10 mainframe) must be in the V position. The 100 KHz decade is set to V when the required deviation is greater than 6 KHz (wideband modulation). The 10 KHz decade is set to V when the deviation is less than 6 KHz (narrowband modulation). (See Figure 4-1.)



Switch	Switch Position	Deviation
100 KHz	V	Wideband (6 KHz)
10 KHz	V	Narrowband (6 KHz)

Figure 4-1. Control Positions for Modulation

4-2. When the 100 KHz switch is at V, the 10 KHz and 1 KHz switches are inoperative. Similarily when the 10 KHz is at V, the 1 KHz switch is inoperative.

To compensate for the fact that these switches are inoperative, the 0-1 KHz control is designed to take over their functions and is set to the value that would otherwise be set up on the decade switches. For example, suppose a frequency of 197.8326 MHz is to be set for (a) narrowband deviation and (b) wideband deviation.

a. For narrowband deviation the decades are set up as in Figure 4-2a. The 0-1 KHz control is set to 3.26 to compensate for the fact that the 10 KHz and 1 KHz controls are inoperative.
Note: Due to lack of resolution, the 0-1 KHz control can only be set to two places, so in practice it would be set to 3.2.

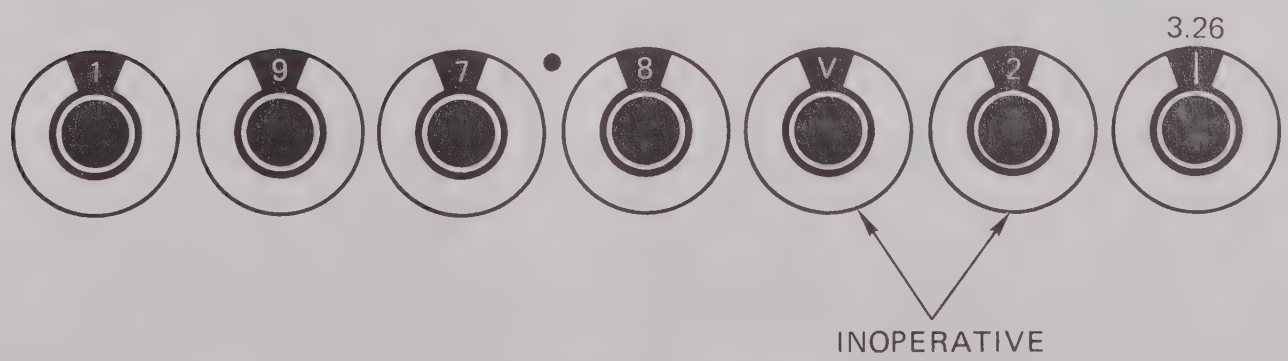


Figure 4-2a. Narrowband Operation

b. For wideband deviation, the decades are set up as in Figure 4-2b. The 0-1 KHz control is set to 8.326 to compensate for the fact that the 100 KHz, 10 KHz and 1 KHz controls are inoperative.

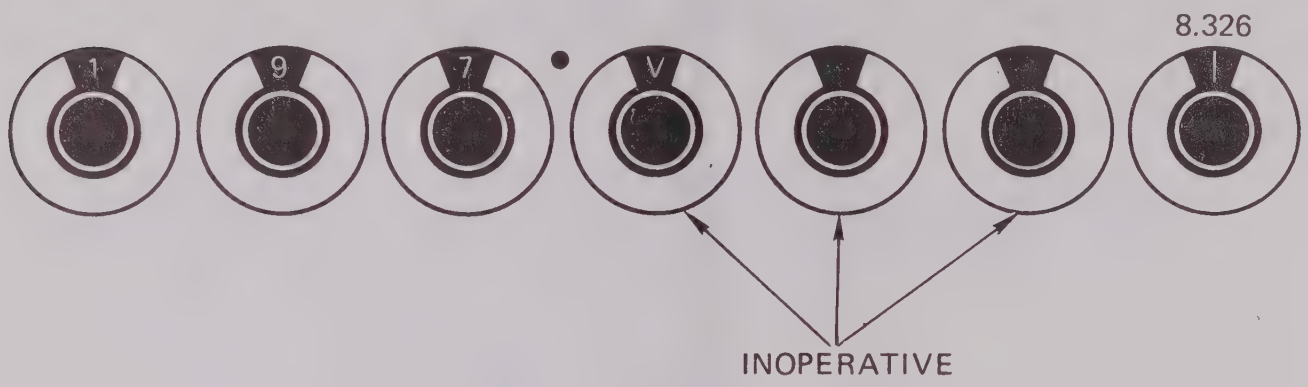


Figure 4-2b. Wideband Operation

4-3. CIRCUIT DESCRIPTION. (See Figure 4-3, Block Diagram.)

The MDM-1 consists of: a 2MHz IF Amplifier; Limiter/Discriminator; Threshold Detector for minimum IF signal level; Peak Detector; Auxiliary Audio Amplifier (for listening to recovered audio); 1 KHz Oscillator and Amplifier.

4-3-1. IF Amplifier and Filter

The IF amplifier and filter consists of Q1, L1, L2, and L3. It amplifies the 2 MHz IF signal which is derived by mixing the incoming signal with the synthesized FM-10 signal offset by 2 MHz. The output is supplied to the limiter/discriminator and the signal threshold detector.

4-3-2. Limiter/Discriminator

This is a quadrature-type discriminator consisting of U1. Its output is provided through emitter follower Q5 to the front panel SCOPE/DIST/ANAL connector, J1. The discriminator output is also supplied to the range divider network, R16, R17, R18, and R19 and thereafter to FET amplifier, Q6. The desired range is selected by switch S1, DEV RANGE. There are two identical signals out of Q6, 180° apart in phase. These signals allow positive or negative-going peaks to be read on the front-panel deviation meter. One of the two signals is selected by switch S2 (DEV, +, -) and supplied to the auxiliary audio amplifier.

4-3-3. Signal Threshold Detector

The input to the signal threshold detector is taken from the 2 MHz IF amplifier and filter. It is amplified by Q2 and Q3 and detected by diode CR7 and Q4. The output is a dc voltage proportional to the IF signal level which is fed to meter switch S3. With the switch in the MTR LIM mode, the output of the threshold detector is applied to meter M1 which reads limiter current. The minimum allowable limiter current is marked on the meter scale.

4-3-4. Auxiliary Audio Amplifier

The auxiliary audio amplifier consists of Q7, Q8, and Q9. It supplies the FM-10 mainframe audio amplifier with the recovered audio signal via pin J11-14.

4.3.5 Peak Detector

The peak detector consists of U2 and derives its input from Q8. U2 supplies a dc voltage proportional to the peak value of the audio signal to meter switch S3. With S3 in the DEV mode the meter indicates frequency deviation in Kilohertz.

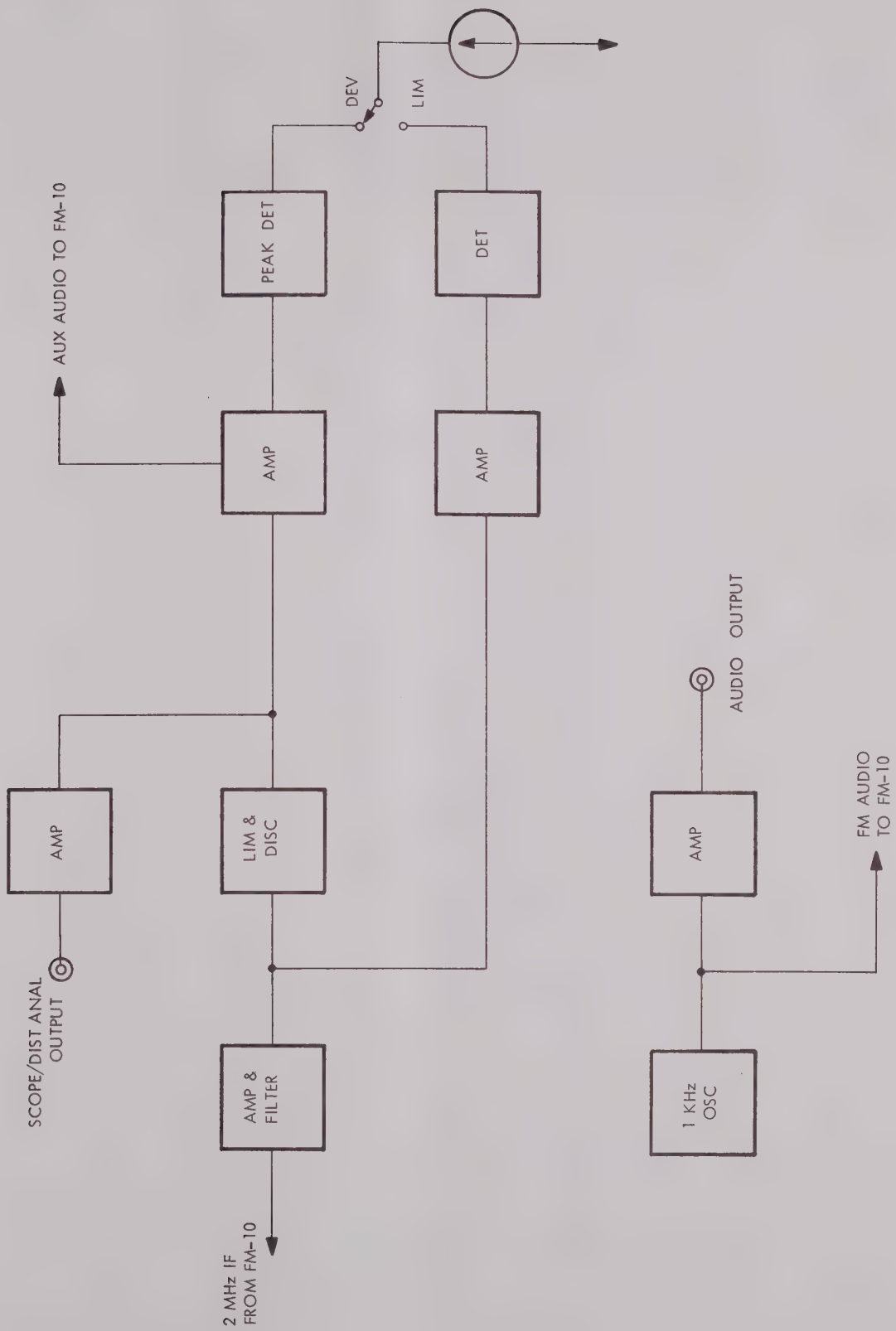


Figure 4-3. Block Diagram

4-3-6. Audio Oscillator

The MDM-1 contains its own 1 KHz Wein bridge oscillator consisting of Q10, Q11, Q12, and Q15. The oscillator is of conventional design with the exception that amplitude leveling is accomplished by Q15 whose resistance varies with a dc voltage so that there is self-leveling. The oscillator frequency is adjusted by R56. The output of the oscillator goes to the FM-10 mainframe for modulation purposes via pin J11-12. An external test tone frequency can be injected into the FM-10 via front panel connector J2, EXT MOD. The oscillator output is also supplied to the audio driver amplifier Q13 and Q14 for the high-level output controlled in amplitude by R63. The 1 KHz output is available at front panel connector J3 (AUDIO OUT) for modulation of external transmitters.

SECTION V
CALIBRATION

5-1. TEST EQUIPMENT REQUIRED.

(1) Model FM-10

(2) AC/DC Differential Voltmeter - Fluke Model 883A or equivalent

(3) MDM-1 Extender Cable - Singer Part Number PC 2653

(4) Signal Generator - Hewlett Packard Model 608 or equivalent

(5) VTVM - Hewlett Packard Model 410C or equivalent

(6) Frequency Counter - Hewlett Packard Model 5532A or equivalent

(7) Distortion Analyzer - Hewlett Packard Model 331A or equivalent

5-2. 1 KHz OSCILLATOR ALIGNMENT

5-2-1. Remove MDM-1 from mainframe.

5-2-2. Using the extender cable (PC 2653), connect MDM-1 to FM-10.

5-2-3. Set FM-10 and MDM-1 controls as follows:

	Control	Position
FM-10	PWR	IN/AC
	Audio	OUT/MOD
	Volume	Counter Clockwise
	Frequency	12.0V0 (0-1 KHz set to 0)
	10 MHz	IN
MDM-1	MTR	DEV/OUT
	MOD	INT/COMB
	INT MOD/AUDIO OUT	Fully Clockwise
	DEVIATION RANGE	18 KHz

5-2-4. Connect VTVM (AC) to EXT MOD connector. 600Ω load ?

5-2-5. Adjust R58 for approximately 180 mV on VTVM.

5-2-6. Connect counter to EXT MOD connector.

5-2-7. Adjust R56 for a frequency of 1 KHz ±50 Hz on the counter.

5-2-8. Connect VTVM to AUDIO OUT connector with a 600 Ω termination (a 560 Ω resistor may be used).

5-2-9. Set MOD switch to EXT/AUDIO OUT.

5-2-10. Adjust R58 for exactly 1V reading on VTVM. Recheck frequency with counter and adjust R56 if necessary while maintaining 1V output at the audio connector into a 600 Ω load.

5-2-11. Connect distortion analyzer to AUDIO OUT connector and measure distortion. Distortion should not exceed 1%.

5-3. IF, LIMITER, AND DEVIATION RANGE ALIGNMENT.

NOTE: The IF filter consisting of L1, L2, and L3, and discriminator coil L4 are factory aligned and should not require field alignment.

5-3-1. Remove MDM-1 from mainframe.

5-3-2. Using the extender cable PC 2653 connect MDM-1 to FM-10.

5-3-3. Set FM-10 and MDM-1 controls as follows:

	Control	Position
FM-10	PWR	IN/AC
	10 MHz	IN
	AUDIO	OUT/MOD
	VOLUME	CLOCKWISE
	FREQUENCY	12.0V0 MHz (0-1 KHz set to 0)
MDM-1	MTR	DEV/OUT
	MOD	EXT/OUT
	INT MOD/AUDIO OUT	FULLY CLOCKWISE
	DEVIATION RANGE	18 KHz

5-3-4. Connect cable from AUDIO OUT to EXT MOD connectors on the MDM-1.

5-3-5. Observe a 1 KHz audio signal in the FM-10 speaker and a reading on the MDM-1 meter. This indicates the MDM-1 is operational and further calibration may proceed.

5-3-6. Connect differential voltmeter to the MDM-1 SCOPE/DIST ANAL output connector. Use care in connecting to ~~SCOPE/DIST ANAL~~ as a short may damage the MDM-1.

1. ~~INPUT OF MODIFICATION~~ D: DISCONNECT WIRE FROM PIN 5 and CONN

5-3-7. Set FM-10 frequency controls to 12.000 MHz and the 0-1 KHz control to OUT.

5-3-8. Measure and record for reference the DC voltage reading on the differential voltmeter (4.5 to 5.5 volts).

5-3-9. Set FM-10 frequency controls to 12.006 MHz with 0-1 KHz control at OUT.

5-3-10. Measure and record the new DC voltage reading on the differential voltmeter.

5-3-11. Subtract voltage reading taken in step 5-3-8 from that taken in step 5-3-10 and multiply this difference by 0.707.

5-3-12. Set the differential voltmeter for AC and dial in the result obtained in step 5-3-11.

5-3-13. Set FM-10 frequency controls to 12.0V0 MHz with 0-1 KHz control to 0. Ensure that the 10 MHz switch is in the IN position.

5-3-14. Set MDM-1 deviation range switch to 6 KHz and MOD switch to INT/COMB.

5-3-15. Adjust INT MOD/AUDIO OUT control on the MDM-1 for null on the differential voltmeter. If null cannot be obtained adjust R65 until null can be obtained.

5-3-16. Adjust R47 on the MDM-1 for exactly full scale reading (6 KHz) on the MDM-1 meter. Alternately depress and release the DEV + or - switch and adjust R47 such that the average of these two readings is full scale (6 KHz). Disconnect the differential voltmeter after this has been completed.

5-3-17. Rotate INT MOD/AUDIO OUT control on the MDM-1 fully clockwise. Adjust R65 for slightly over full scale reading on the MDM-1 meter.

5-3-18. Remove extender cable from MDM-1 and FM-10 and plug the MDM-1 directly into the FM-10.

5-3-19. Set MDM-1 MTR switch to LIM.

BOB
763-8485

5-3-20. Set signal generator to 150 MHz at 6 mv output and connect it to the FM-10 MEAS INPUT through a short cable.

5-3-21. Set FM-10 frequency controls to 150.000 MHz with 0-1 KHz control in OUT. Set AUDIO switch to IN/BEAT position.

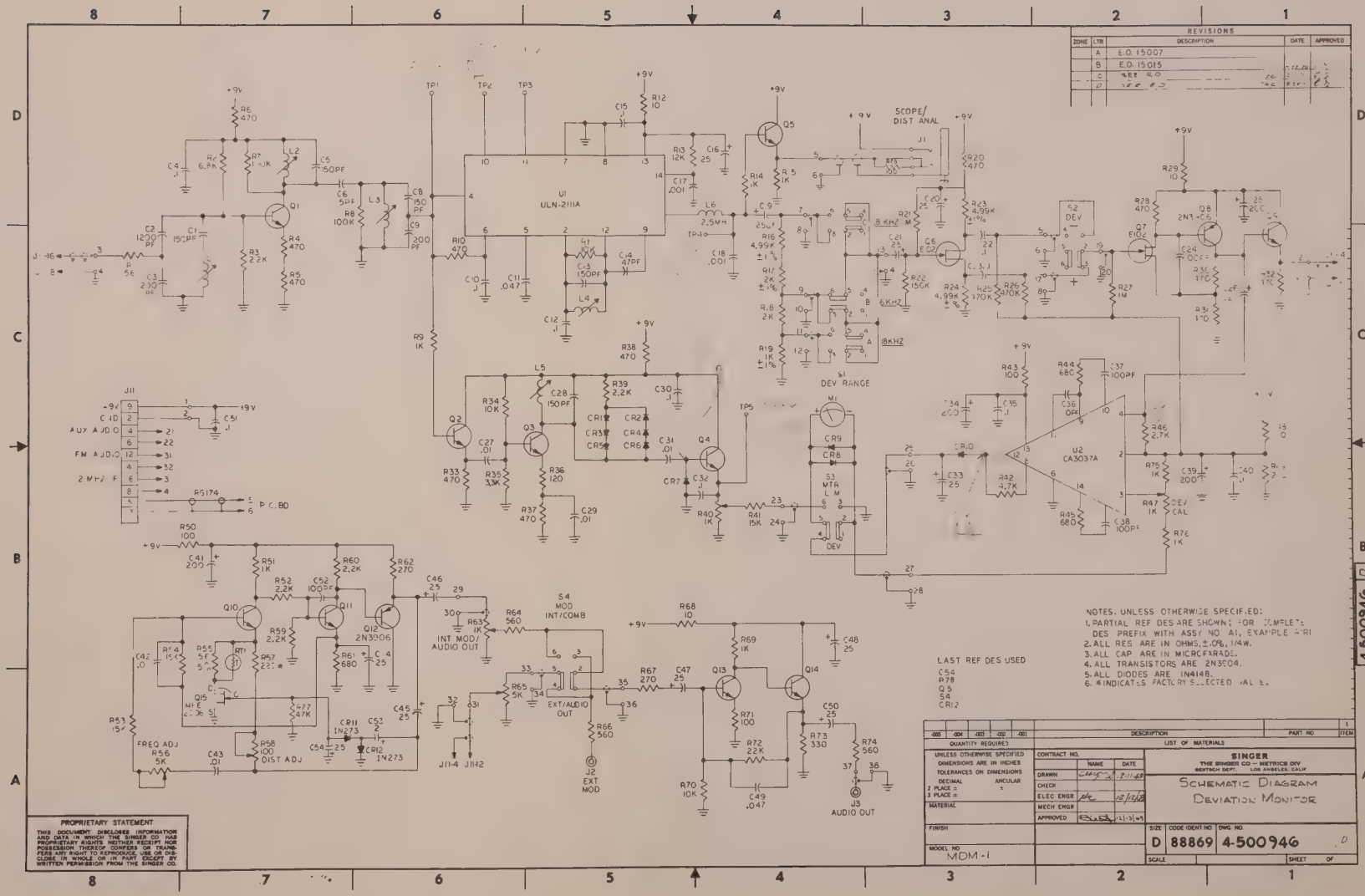
5-3-22. Adjust signal generator carefully for zero beat as indicated by the FM-10 speaker and beat meter.

5-3-23. Set FM-10 frequency controls to 152.000 with 0-1 KHz control in OUT. Set 10 MHz switch to OUT. Set audio switch to OUT/MOD.

5-3-24. Observe limiter current reading on MDM-1 Meter. Reading should be slightly above "Red Line" indication. If necessary unplug MDM-1 and adjust R40 to obtain this.

NOTE: Due to drift in the signal generator it may be necessary to repeat steps 5-3-22 through 5-3-24 to obtain correct reading of limiter current.

SECTION VI
SCHEMATIC


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
A E.O. 15007
B E.O. 15015
U1 ULN-2111A
U2 CA3037A
SCOPE/ DIST ANAL
DEV RANGE
S3 MTR LM DEV
S4 MOD INT/COMB
INT MOD/ AUDIO OUT
EXT/AUDIO OUT
EXT MOD
AUDIO OUT
FREQ ADJ R56 5K
DIST ADJ R58 100
NOTES: UNLESS OTHERWISE SPECIFIED:
1. PARTIAL REF DES ARE SHOWN; FOR COMPLETE DES PREFIX WITH ASSY NO AI, EXAMPLE A1R1
2. ALL RES ARE IN OHMS, 2.0%, 1/4W.
3. ALL CAP ARE IN MICROFARADS.
4. ALL TRANSISTORS ARE 2N3904.
5. ALL DIODES ARE IN4148.
6. * INDICATES FACTORY SELECTED VALUE.
LAST REF DES USED
C54
P78
Q5
S4
CR12
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LIST OF MATERIALS
QUANTITY REQUIRED | DESCRIPTION | PART NO | ITEM
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS DECIMAL ANGULAR
2 PLACE ± 3 PLACE ±
MATERIAL
FINISH
MODEL NO MDM-1
CONTRACT NO.
DRAWN
CHECK
ELEC ENGR
MECH ENGR
APPROVED
SINGER THE SINGER CO — METRICS DIV BENTSCH DEPT. LOS ANGELES, CALIF
SCHEMATIC DIAGRAM DEVIATION MONITOR
SIZE D | CODE IDENT NO 88869 | DWG NO 4-500946 D
SCALE | SHEET OF
4-500946 D

Figure 6-1. Schematic Diagram

SECTION VII
PARTS LIST

PARTS LIST

REF DES	DESCRIPTION	SINGER P/N	MFR	MFR'S P/N	QTY
C1	Capacitor 150pf	1-900003-034	Electromotive	DM15	1
C2, C3	Capacitor 1200pf	1-900003-057	Electromotive	DM15	2
C4	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C5	Capacitor 150pf	1-9000003-034	Electromotive	DM15	1
C6	Capacitor 5pf	1-900003-004	Electromotive	DM15	1
C8	Capacitor 150pf	1-900003-034	Electromotive	DM15	1
C9	Capacitor 1200pf	1-900003-057	Electromotive	DM15	1
C10	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C11	Capacitor .047uf	1-900001-009	Amperex	C280AE	1
C12	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C13	Capacitor 150pf	1-900003-034	Electromotive	DM15	1
C14	Capacitor 47pf	1-900003-021	Electromotive	DM15	1
C15	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C16	Capacitor 25uf	1-900039-001	Gen. Instrument Corp	984-118	1
C17, C18	Capacitor .001uf	1-900012-002	Sprague	5GA-S50	2
C19, C20, C21	Capacitor 25uf	1-900039-001	Gen. Instrument Corp	984-118	3
C22, C23	Capacitor .1uf	1-900001-013	Amperex	C280AE	2
C24	Capacitor 100pf	1-900003-030	Electromotive	DM15	1
C25	Capacitor 200uf	1-900039-002	Gen. Instrument Corp	984-141	1
C26	Capacitor 25uf	1-900039-001	Gen. Instrument Corp	984-118	1
C27	Capacitor .01uf	1-900001-001	Amperex	C280AE	1
C28	Capacitor 150pf	1-900003-034	Electromotive	DM15	1
C29	Capacitor .01uf	1-900001-001	Amperex	C280AE	1
C30	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C31	Capacitor .01uf	1-900001-001	Amperex	C280AE	1
C32	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C33	Capacitor 25uf	1-900039-001	Gen. Instrument Corp	984-118	1
C34	Capacitor 200uf	1-900039-002	Gen. Instrument Corp	984-141	1

REF DES	DESCRIPTION	SINGER P/N	MFR	MFR'S P/N	QTY
C35	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C36	Capacitor 10pf	1-900003-008	Electromotive	DM15	1
C37, C38	Capacitor 100pf	1-900003-030	Electromotive	DM15	2
C39	Capacitor 200uf	1-900039-002	Gen. Instrument Corp	984-141	1
C40	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C41	Capacitor 200uf	1-900039-002	Gen. Instrument Corp	984-141	1
C42, C43	Capacitor .01uf	1-900001-001	Amperex	C280AE	2
C44, C45, C46, C47, C48	Capacitor 25uf	1-900039-001	Gen. Instrument Corp	984-118	5
C49	Capacitor .047uf	1-900001-009	Amperex	C280AE	1
C50	Capacitor 25uf	1-900039-001	Gen. Instrument Corp	984-118	1
C51	Capacitor .1uf	1-900001-013	Amperex	C280AE	1
C52	Capacitor 100pf	1-900003-030	Electromotive	DM15	1
C53	Capacitor 2uf	1-900023-016	Sprague	TE1201	1
C54	Capacitor 25uf	1-900039-001	Gen. Instrument Corp	984-118	1
CR11, CR12	Diode 1N273	1-913005-001	Transitron Electronic Corp	1N273	2
CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR10	Diode 1N4148	1-913007-001	General Electric	1N4148	8
L1, L2, L3, L4, L5	Coil, Var 30-60uh	1-906006-003	Precision Coil	CR23	5
L6	Coil 2.5uh	1-906002-054	J.W.Miller Co	70F253AI	1
Q1, Q2, Q3, Q4, Q5	Transistor 2N3904-5	1-958000-001	Motorola	2N3904-5	5
Q6, Q7	Transistor E102	1-958031-003	Siliconics	E102	2
Q8	Transistor 2N3906-5	1-958000-002	Motorola	2N3906-5	1
Q9, Q10, Q11	Transistor 2N3904-5	1-958000-001	Motorola	2N3904-5	3
Q12	Transistor 2N3906-5	1-958000-002	Motorola	2N3906-5	1

REF DES	DESCRIPTION	SINGER P/N	MFR	MFR'S P/N	QTY
Q13, Q14	Transistor 2N3904-5	1-958000-001	Motorola	2N3904-5	2
Q15	Transistor MFE2006	1-958044-003	Motorola	MFE2006	1
R1	Resistor, Carbon 56 ohm	1-945000-022	Allen-Bradley	Type CB	1
R2	Resistor, Carbon 6.8K	1-945000-047	Allen-Bradley	Type CB	1
R3	Resistor, Carbon 2.2K	1-945000-041	Allen-Bradley	Type CB	1
R4, R5, R6	Resistor, Carbon 470 ohm	1-945000-033	Allen-Bradley	Type CB	3
R7, R8	Resistor, Carbon 100K	1-945000-061	Allen-Bradley	Type CB	2
R9	Resistor, Carbon 1K	1-945000-037	Allen-Bradley	Type CB	1
R10	Resistor, Carbon 470 ohm	1-945000-033	Allen-Bradley	Type CB	1
R11	Resistor, Carbon 10K	1-945000-049	Allen-Bradley	Type CB	1
R12	Resistor, Carbon 10 ohm	1-945000-013	Allen-Bradley	Type CB	1
R13	Resistor, Carbon 12K	1-945000-050	Allen-Bradley	Type CB	1
R14, R15	Resistor, Carbon 1K	1-945000-037	Allen-Bradley	Type CB	2
R16	Resistor, Carbon 4.99K 1%	1-945016-260			1
R17, R18	Resistor, Carbon 2K 1%	1-945016-222			2
R19	Resistor, Carbon 1K 1%	1-945016-193			1
R20	Resistor, Carbon 470 ohm	1-945000-033	Allen-Bradley	Type CB	1
R21	Resistor, Carbon 1 meg	1-945000-073	Allen-Bradley	Type CB	1
R22	Resistor, Carbon 150K	1-945000-063	Allen-Bradley	Type CB	1
R23, R24	Resistor, Carbon 4.99K 1%	1-945016-260			2
R25, R26	Resistor, Carbon 470K	1-945000-069	Allen-Bradley	Type CB	2
R27	Resistor, Carbon 1 meg	1-945000-073	Allen-Bradley	Type CB	1
R28	Resistor, Carbon 470 ohm	1-945000-033	Allen-Bradley	Type CB	1
R29	Resistor, Carbon 10 ohm	1-945000-013	Allen-Bradley	Type CB	1
R30, R31, R32, R33	Resistor, Carbon 470 ohm	1-945000-033	Allen-Bradley	Type CB	4
R34	Resistor, Carbon 10K	1-945000-049	Allen-Bradley	Type CB	1
R35	Resistor, Carbon 3.3K	1-945000-043	Allen-Bradley	Type CB	1
R36	Resistor, Carbon 120 ohm	1-945000-026	Allen-Bradley	Type CB	1
R37, R38	Resistor, Carbon 470 ohm	1-945000-033	Allen-Bradley	Type CB	2
R39	Resistor, Carbon 2.2K	1-945000-041	Allen-Bradley	Type CB	1

REF DES	DESCRIPTION	SINGER P/N	MFR	MFR'S P/N	QTY
R40	Resistor, Var 1K	1-945010-004	Chicago Telephone Supply	Type U201	1
R41	Resistor, Carbon 15K	1-945000-051	Allen-Bradley	Type CB	1
R42	Resistor, Carbon 4.7K	1-945000-045	Allen-Bradley	Type CB	1
R43	Resistor, Carbon 100 ohm	1-945000-025	Allen-Bradley	Type CB	1
R44, R45	Resistor, Carbon 680 ohm	1-945000-035	Allen-Bradley	Type CB	2
R46	Resistor, Carbon 2.7K	1-945000-042	Allen-Bradley	Type CB	1
R47	Resistor, Var 1K	1-945010-004	Chicago Telephone Supply	Type U201	1
R48	Resistor, Carbon 470 ohm	1-945000-033	Allen-Bradley	Type CB	1
R49	Resistor, Carbon 270 ohm	1-945000-030	Allen-Bradley	Type CB	1
R50	Resistor, Carbon 100 ohm	1-945000-025	Allen-Bradley	Type CB	1
R51	Resistor, Carbon 1K	1-945000-037	Allen-Bradley	Type CB	1
R52	Resistor, Carbon 2.2K	1-945000-041	Allen-Bradley	Type CB	1
R53, R54	Resistor, Carbon 15K	1-945000-051	Allen-Bradley	Type CB	2
R55	Resistor, Carbon 56 ohm 5%	1-945000-132	Allen-Bradley	Type CB	1
R56	Resistor, Var 5K	1-945010-006	Chicago Telephone Supply	Type U201	1
R57	Resistor, Carbon 150 ohm	1-945000-027	Allen-Bradley	Type CB	1
R58	Resistor, Var 100 ohm	1-945010-001	Chicago Telephone Supply	Type U201	1
R59, R60	Resistor, Carbon 2.2K	1-945000-041	Allen-Bradley	Type CB	2
R61	Resistor, Carbon 680 ohm	1-945000-035	Allen-Bradley	Type CB	1
R62	Resistor, Carbon 270 ohm	1-945000-030	Allen-Bradley	Type CB	1
R65	Resistor, Var 5K	1-945010-006	Chicago Telephone Supply	Type U201	1
R67	Resistor, Carbon 270 ohm	1-945000-030	Allen-Bradley	Type CB	1
R68	Resistor, Carbon 10 ohm	1-945000-013	Allen-Bradley	Type CB	1
R69	Resistor, Carbon 1K	1-945000-037	Allen-Bradley	Type CB	1
R70	Resistor, Carbon 10K	1-945000-049	Allen-Bradley	Type CB	1
R71	Resistor, Carbon 100 ohm	1-945000-025	Allen-Bradley	Type CB	1
R72	Resistor, Carbon 22K	1-945000-053	Allen-Bradley	Type CB	1
R73	Resistor, Carbon 330 ohm	1-945000-031	Allen-Bradley	Type CB	1
R74	Resistor, Carbon 560 ohm	1-945000-034	Allen-Bradley	Type CB	1
R75, R76	Resistor, Carbon 1K	1-945000-037	Allen-Bradley	Type CB	1
R77	Resistor, Carbon 47K	1-945000-057	Allen-Bradley	Type CB	1
RT-1	Thermistor	1-945070-001	Fenwall Electronics	KB23J(300Ω)	1
U1	Integrated Circuit ULN-2111A	1-926031-001	Sprague	ULN-2111A	1
U2	Integrated Circuit CA3037A	1-926033-001	RCA	CA3037A	1

M1 [illegible] R - 1-937005-001 Loc. 14-85

ADDENDUM TO MANUAL 1-500783-156

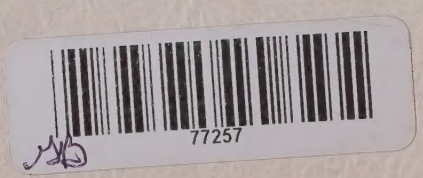
MODEL MDM-1

A. NOISE ON 1.5KHz RANGE WITH INTERNAL MODULATION

When the 10KHz or 100KHz frequency selectors are in the "V" position (required for internal modulation) there is sometimes a noticeable amount of noise present on the 1,8KHz range (approximately 1 division on the scale). This is caused by various signals used in the synthesis process and is normal for this mode of operation. Since this noise appears to "ride along" on the desired waveform, there is no loss of measurement accuracy of the desired signal deviation if the average value of this noise on the peaks of the desired waveform is considered.

B. RECOMMENDED PROCEDURE FOR TRANSMITTER FM MEASUREMENTS WITH SMALL DEVIATIONS (1.5KHz RANGE)

In the setting of the 1KHz, 10KHz, and 100KHz frequency selection controls for measurement of transmitter FM, it is recommended that the final setting of these controls not be in the "V" position in order to minimize noise on the recovered audio waveform.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